

Impacts on Emissions and Air Quality
of alternative fuel mixes in Spain

EUROPEAN ENERGY
MARKETS 2010

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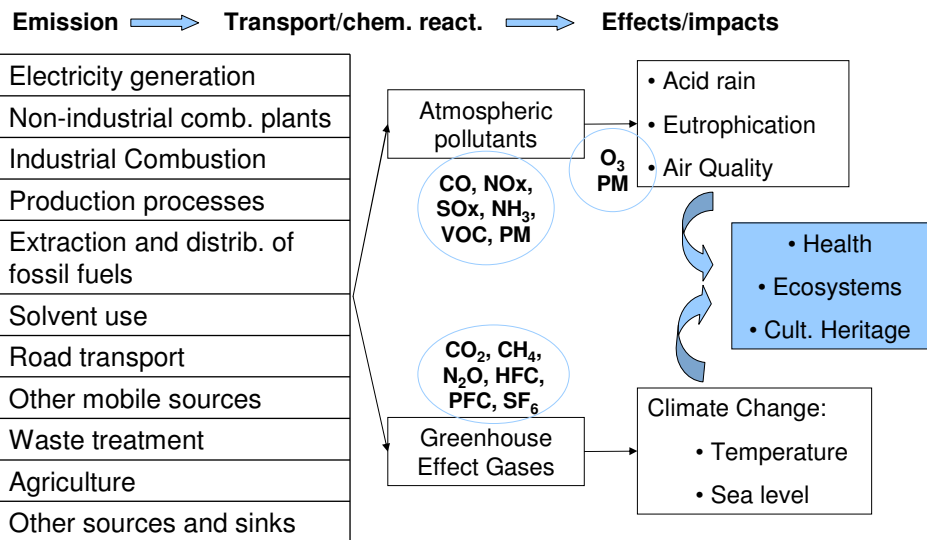


OUTLINE

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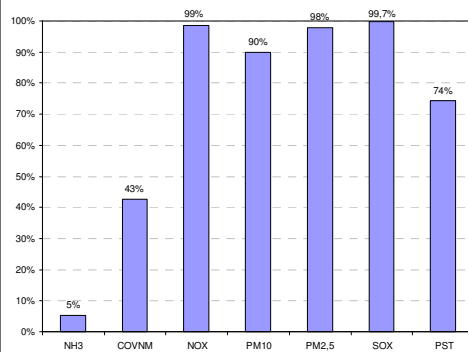


1.- INTRODUCTION



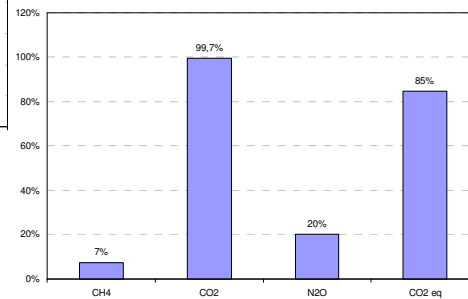


Emissions from energy sector vs. Spanish total (MARM, 2008)



Percentage of energy sector emissions
from total Spanish emissions for 2006

- Energy and transformation industries
- R&C&I
- Industry
- Transport



2.- SCENARIO WITHOUT NATURAL GAS



Reference scenario (2006 official) vs. scenario without Natural Gas

Assumptions under scenario without Natural Gas :

- Energy & transformation: fuel/gas to the historic maximum and coal growth
- RCI: substitution by petroleum products, mainly diesel

- Industry: dependant on the activity and technology:

- co-generation:
petroleum derivatives
- process kilns and
boilers: petrol products,
coal and waste fuels.

- Transport: without any
change

Industrial sector	D	FO	LPG	PC	Coal	CG	C	W
Iron and steel	X	X	X		X	X		
Non-ferrous metal industries	X	X		X	X		X	
Lime production		X		X				
Glass production		X						
Bricks and tiles	X	X		X				
Fine ceramic materials		X						
Pulp and paper		X						X
Chemistry	X	X	X		X			X
Wood	X	X						X
Textile	X	X	X					
Food, drink and tobacco	X	X						X
Machinery and transport equipments	X	X	X	X				

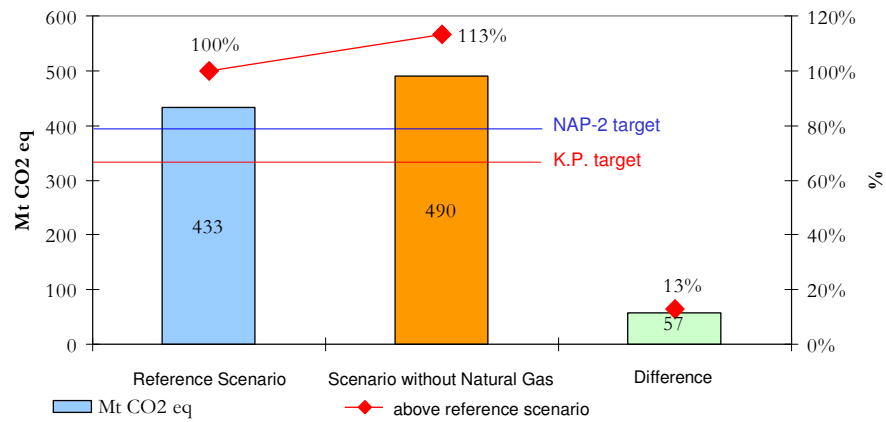


Emissions:

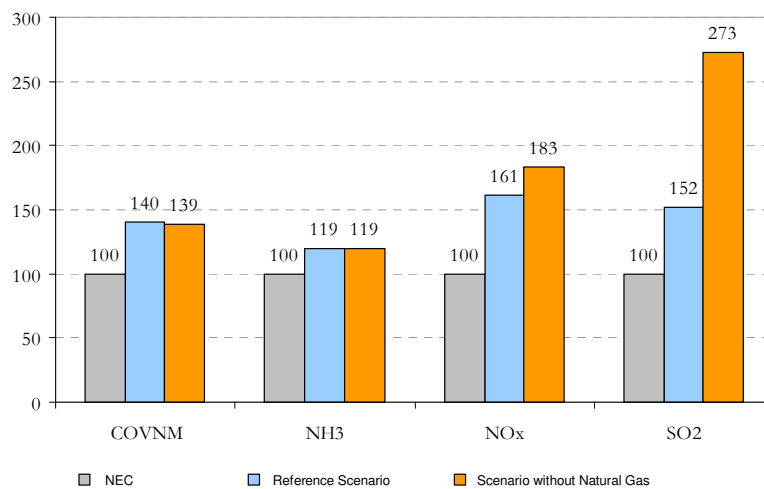
Sector	CO ₂ equiv.	SO ₂	NO _x	NMVOC	PM _{2.5}
Energy and transformation industries	+32%	+69%	+38%	+10%	+63%
Non-industrial combustion	+10%	+90%	+7%	-1%	+7%
Industrial combustion	+16%	+168%	+18%	-17%	+64%
TOTAL	+13%	+77%	+12%	-1%	+14%
NG segment	+23%	+81%	+27%	-5%	+38%



Comparison with Kyoto Protocol target



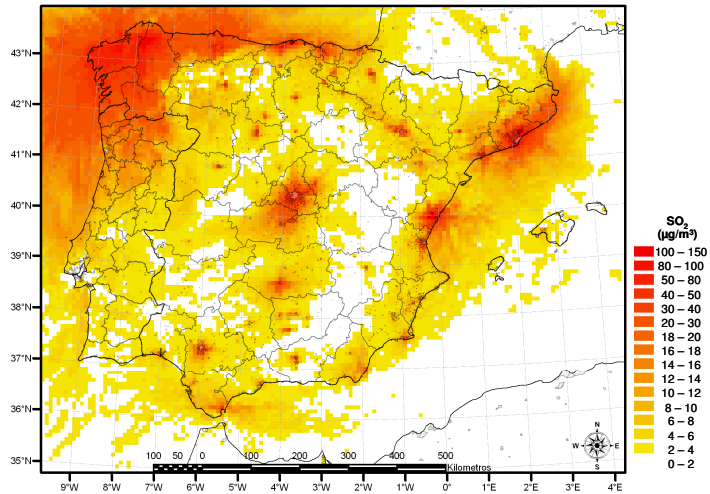
Co-benefits on air pollutants





Co-benefits on air quality (sulphur dioxide, SO₂)

Difference between reference scenario and scenario without NG for the SO₂ daily percentile

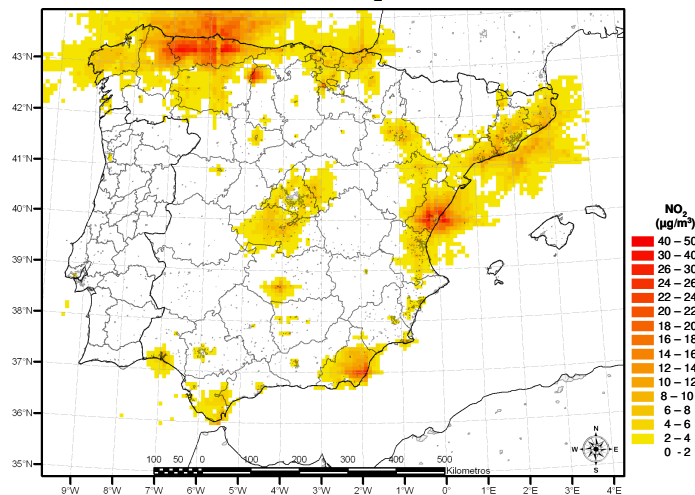


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Co-beneficios on air quality (nitrogen dioxide, NO₂)

Difference between reference scenario and scenario without NG for the NO₂ Hourly 99.8 percentile

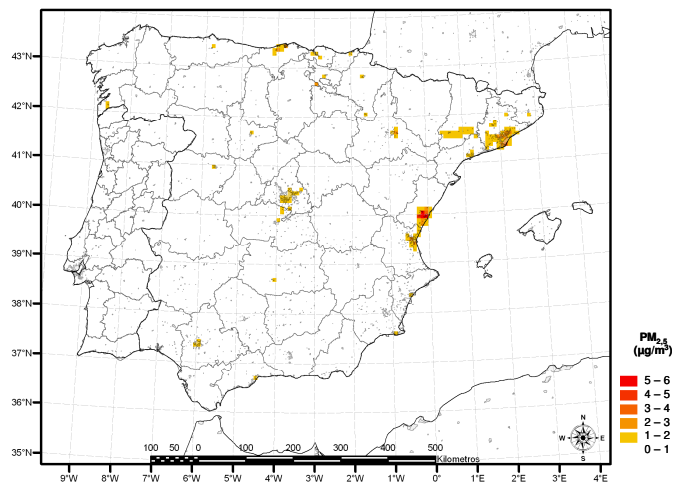


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Co-benefits on air quality (fine particulate mater, $PM_{2.5}$)

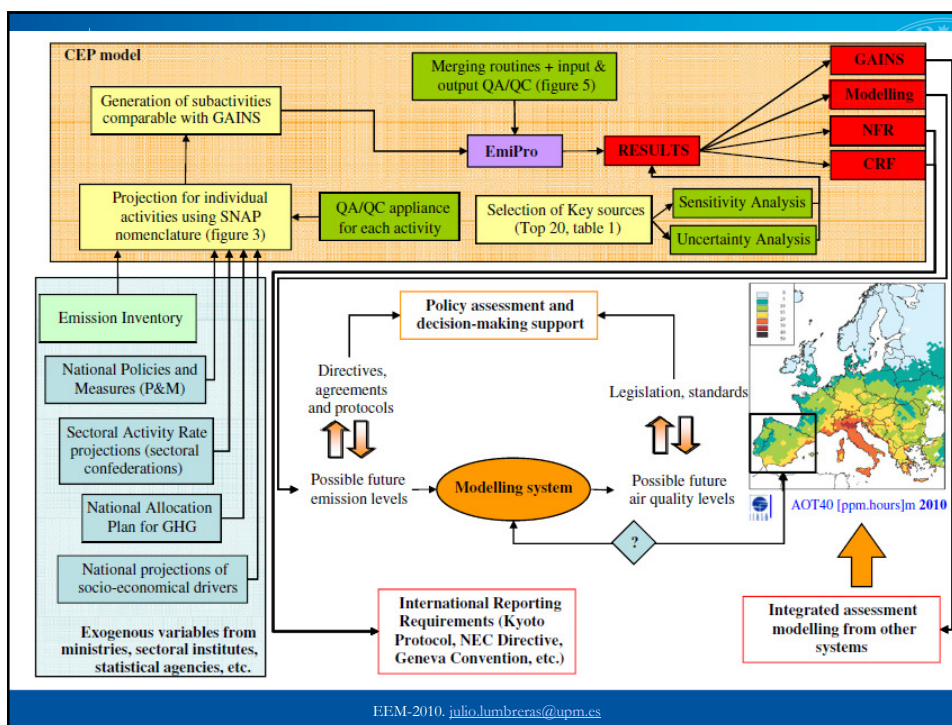
Difference between reference scenario and scenario without NG for the $PM_{2.5}$ annual average



3.- FUTURE SCENARIOS (up to 2020)

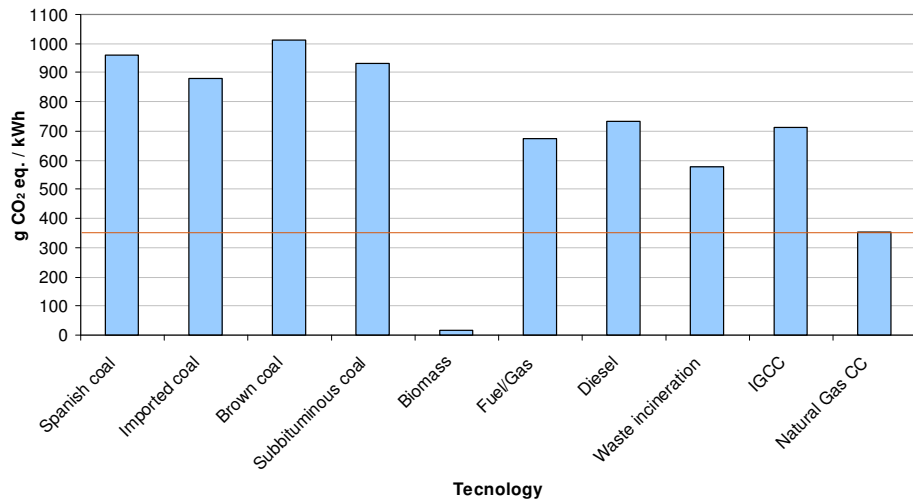
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CO₂ eq. emission factors for electricity generation



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Future scenarios:

- Reference scenario: most likely considering official energy prospective from the Ministry for Energy including sectoral and national legislation and planning
- Fossil scenario without NG: energy demand increase with respect to 2006 is satisfied by fossil fuels different than NG (assuming NG total consumption as in 2006)
- Natural Gas scenario: same energy demand as in the reference scenario but assuming higher NG penetrations

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Natural Gas scenario assumptions (up to 2020):

- Energy and transformation industries: coal substitution with NG
- RCI:
 - co-generation with NG,
 - increase of solar/gas solutions to $15 \cdot 10^6$ m² of solar panels
 - domestic use of NG in every town of more than 10.000 inhabitants
- Industry: co-generation with NG
- Transport:
 - CNG used in 5% of mileage from passenger cars and buses
 - 13% LNG consumption in the national fishing fleet

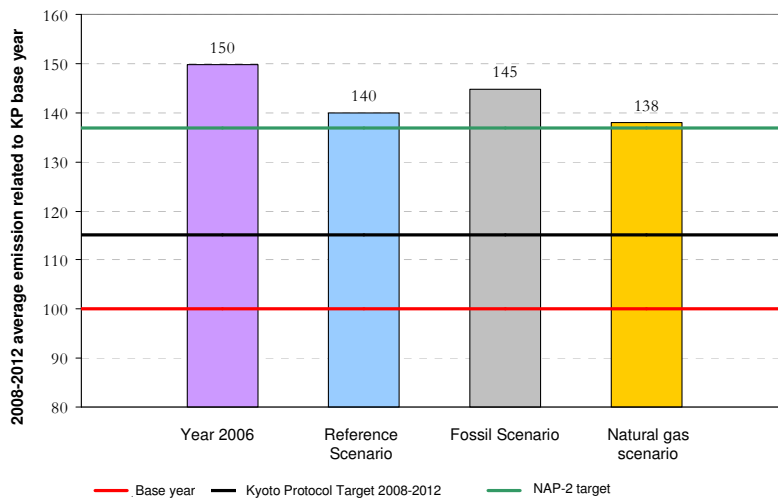


Total results:

Sector	Scenario comparison	2020				
		CO ₂ eq	SO _x	NO _x	NMVOC	PM _{2,5}
National Total	Fossil vs. Ref.	4,0%	53,3%	5,8%	-0,5%	5,3%
	Natural Gas vs. Ref.	-8,2%	-29,2%	-4,5%	0,1%	-5,1%
	Natural Gas vs. Fossil	-11,8%	-53,8%	-9,8%	0,6%	-9,9%
NG sector	Fossil vs. Ref.	7,1%	57,3%	11,2%	-2,3%	13,4%
	Natural Gas vs. Ref.	-13,6%	-31,3%	-8,0%	0,7%	-12,7%
	Natural Gas vs. Fossil	-19,4%	-56,3%	-17,2%	3,1%	-17,2%
Energy sector	Fossil vs. Ref.	4,7%	53,8%	5,9%	-1,8%	5,5%
	Natural Gas vs. Ref.	-9,6%	-29,4%	-4,6%	0,3%	-5,3%
	Natural Gas vs. Fossil	-13,7%	-54,1%	-9,9%	2,1%	-10,2%



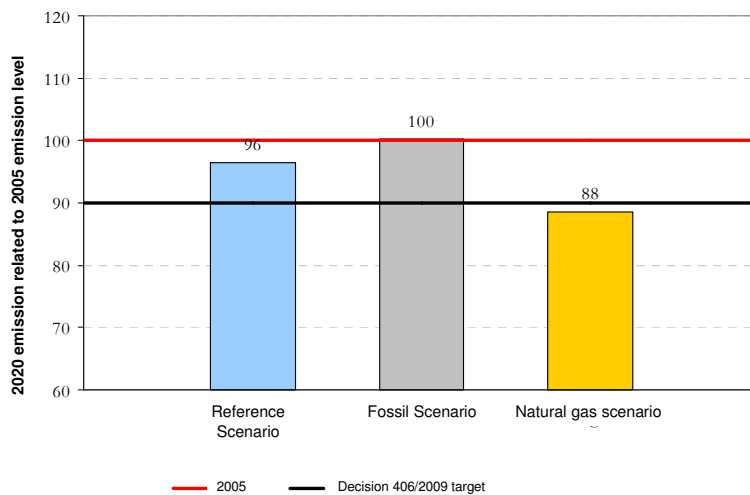
Kyoto Protocol accomplishment



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2020 targets



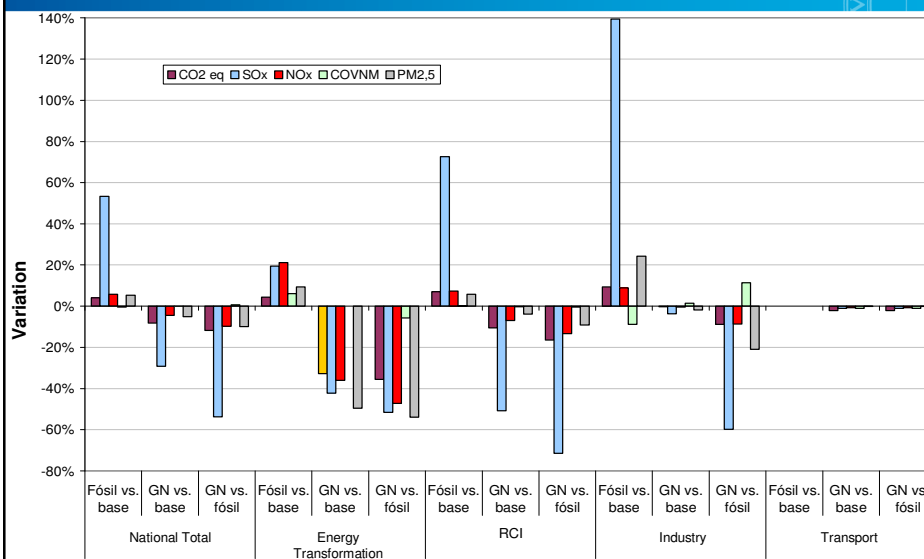
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Sectoral results:

Sector	Scenario comparison	2020				
		CO ₂ eq	SO _x	NO _x	NMVOC	PM _{2,5}
Energy and transformation industries	Fossil vs. Ref.	4,3%	19,4%	21,2%	6,1%	9,4%
	Natural Gas vs. Ref.	-32,8%	-42,3%	-36,0%	0,0%	-49,6%
	Natural Gas vs. Fossil	-35,6%	-51,6%	-47,2%	-5,7%	-53,9%
RCI	Fossil vs. Ref.	7,0%	72,7%	7,3%	0,2%	5,8%
	Natural Gas vs. Ref.	-10,5%	-50,8%	-7,0%	-0,3%	-3,8%
	Natural Gas vs. Fossil	-16,4%	-71,5%	-13,3%	-0,5%	-9,1%
Industry	Fossil vs. Ref.	9,3%	139,5%	8,9%	-8,9%	24,2%
	Natural Gas vs. Ref.	-0,3%	-3,7%	-0,5%	1,5%	-1,9%
	Natural Gas vs. Fossil	-8,8%	-59,8%	-8,6%	11,4%	-21,0%
Transport	Fossil vs. Ref.	0,0%	0,0%	0,0%	0,0%	0,0%
	Natural Gas vs. Ref.	-2,2%	-1,0%	-0,8%	-1,0%	-0,2%
	Natural Gas vs. Fossil	-2,2%	-1,0%	-0,8%	-1,0%	-0,2%

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4.- CONCLUSIONS



- GHG emissions are lower for NG versus other fossil fuel:
 - electricity production: 47%-63%
 - RCI: 17%-53%
 - industry: 14%-49%
- There are important co-benefits:
 - SO₂ emission reductions: less acid rain
 - NO_x emission reductions: lower effects on vegetation, crops, eutrophication, acid rain, etc.
 - Fine PM emission reduction: less mortality and morbidity
- These benefits are shown for a hypothetical situation for 2006 without NG:
 - GHG emissions would have increased in a 13%
 - Other emissions would have raised: SO₂ (77%), PM_{2.5} (14%) y NO₂ (12%)
 - Annual average PM_{2.5} concentrations would have augmented in urban areas
 - NO₂ concentration would be higher than AQ limit values for some regions (Asturias, Comunidad Valenciana and Cataluña)



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- Future scenarios show that:
 - a greater NG penetration would:
 - close KP fulfilment
 - reach 2020 targets
 - reduce SO₂, NO_x and PM_{2,5} emissions
 - an increase in fossil fuels with the same NG consumption would:
 - prevent KP fulfilment
 - distance 2020 targets
 - increase air pollutant emissions



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